SAMPLE ACQUISITION AND CACHING ARCHITECTURES FOR THE MARS2020 MISSION

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HONEYBEE ROBOTICS
Spacecraft Mechanisms Corporation

ISO 9001 CERTIFIED AS9100 CERTIFIED

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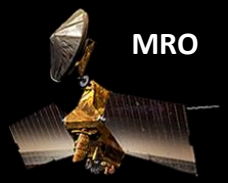
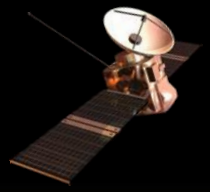
NASA's Mars Exploration Program

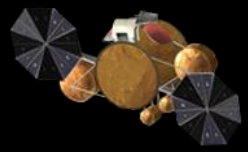
HONEYBEE ROBOTICS

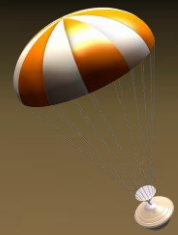
Launch Year

2000 to Present	2011	2013	2016	2018	2020 & Beyond
Odyssey, MRO, Mars Express (ESA)		MAVEN	TGO (ESA-NASA)		Mars Sample Return









MER

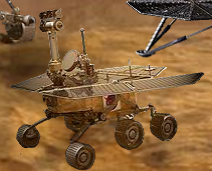
MER

Phoenix

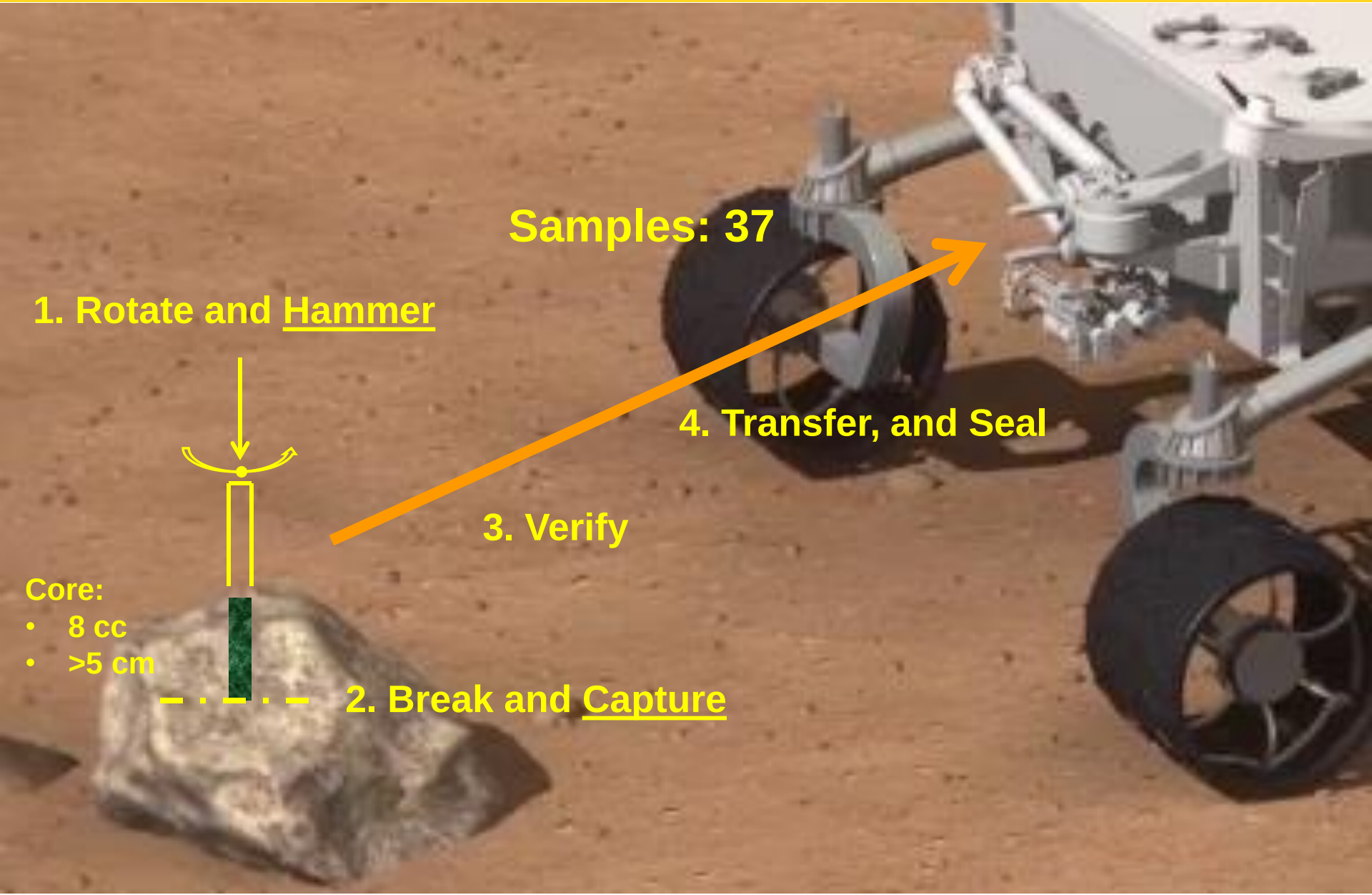
Mars Science Lab

ExoMars

MAX-C Rover



Goal of the M2020 Sampling System

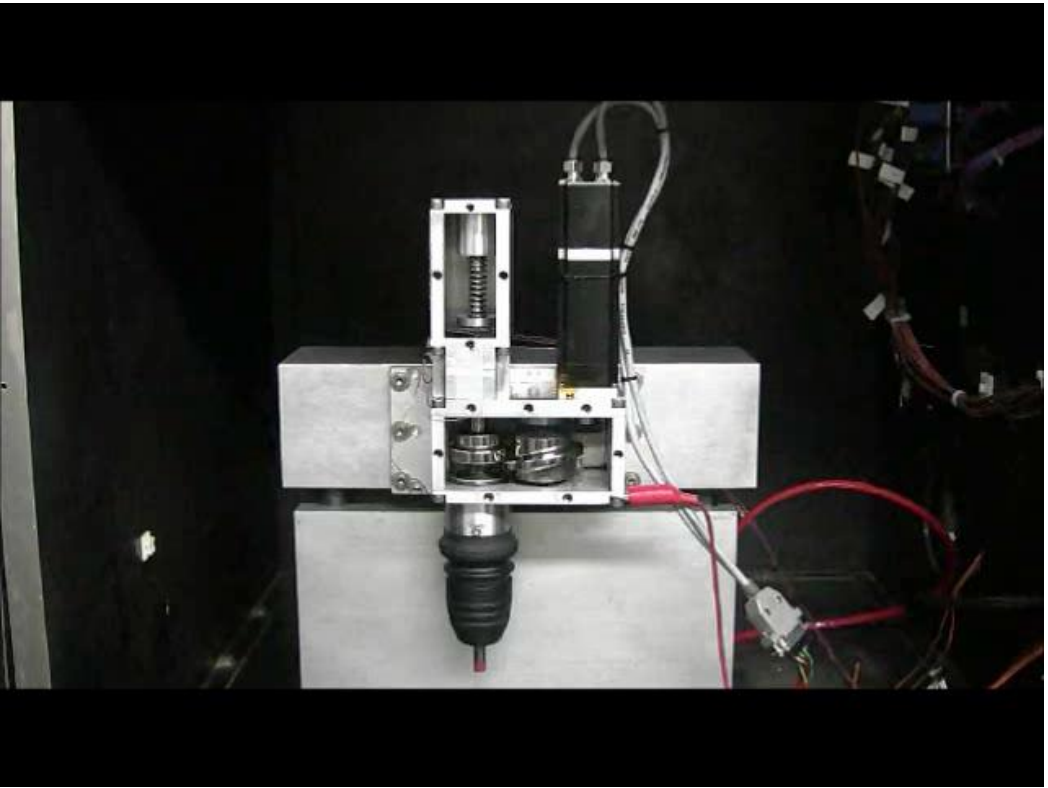


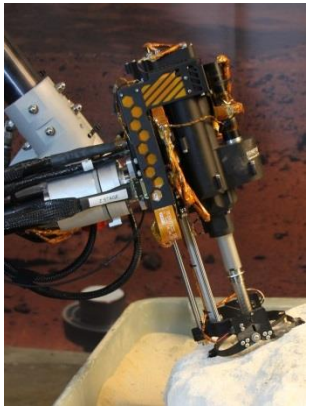
1. Hammer Mechanism

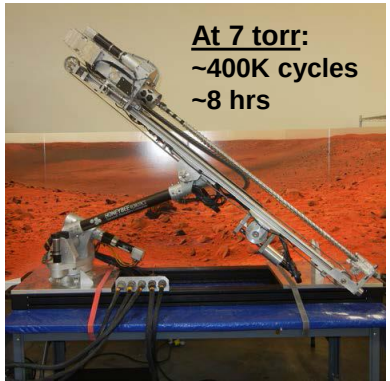
- Investigated various percussive approaches
- Selected cam-spring
  - Apollo “heritage”
  - Mechanically simple
  - Frequency and Energy can be adjusted
  - High blow energy per mechanism mass
- Incorporated into 8 drills systems

At 7 torr:

- **~2M cycles**
- **~19 hrs**

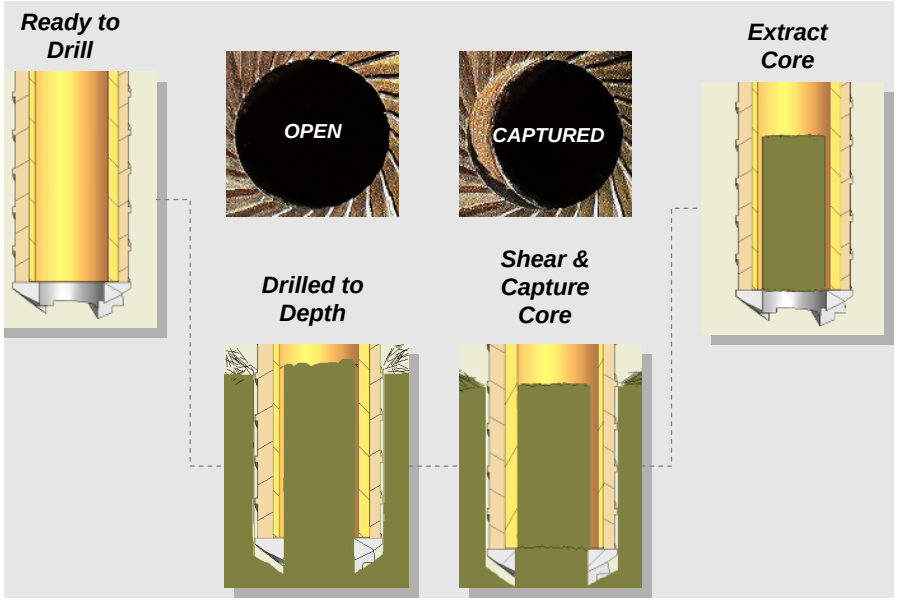






2. Core Breakoff and Retention

- **Shears <u>AND</u> Captures the core**
- **Narrow Kerf:**
  - **Low Weight on Bit**
    - Smaller and Lighter Arm
  - **Lower Power and Faster Drill Time**
    - Lower Energy
    - Smaller Actuators
- **Light and Small Drill Bit**
  - Potential for returning cores in bits



3. Core Observation/Verification

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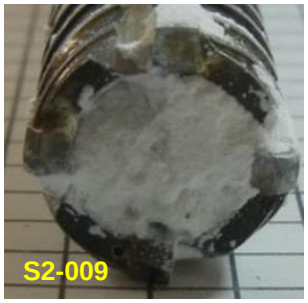
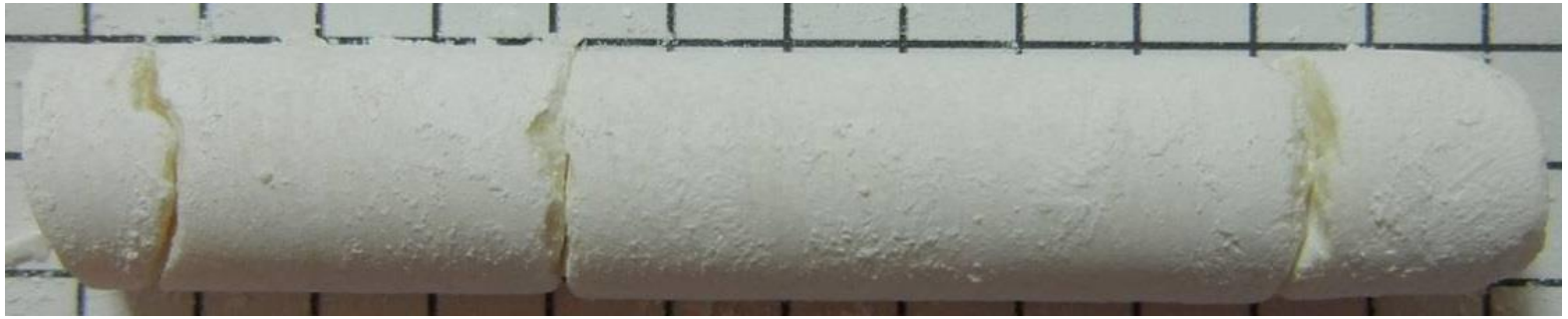
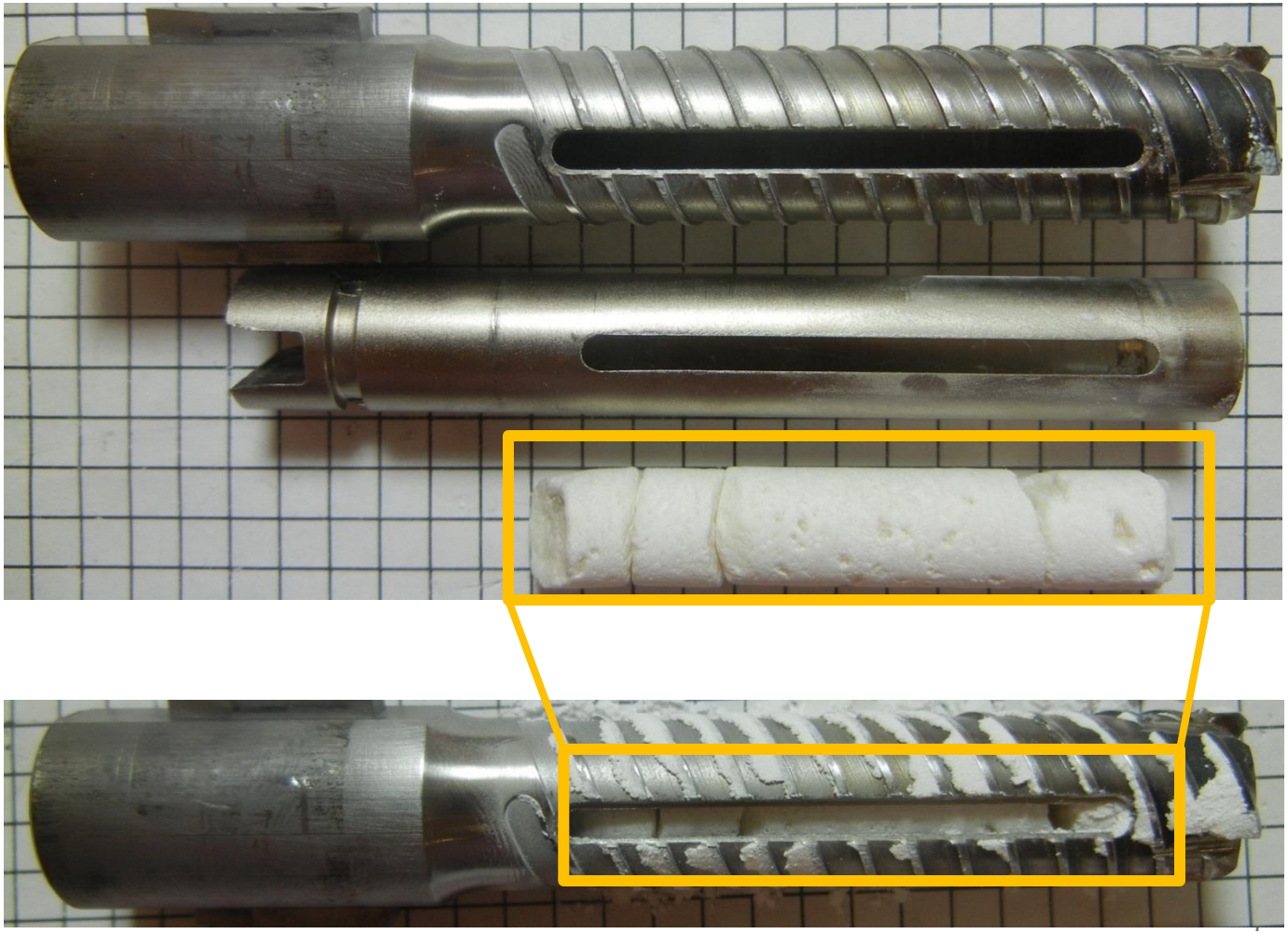


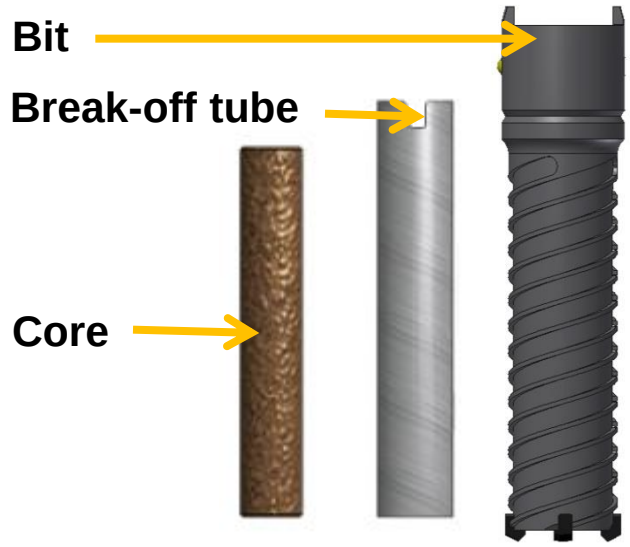


3. SLOT Bit



4. Caching

Bit Assembly

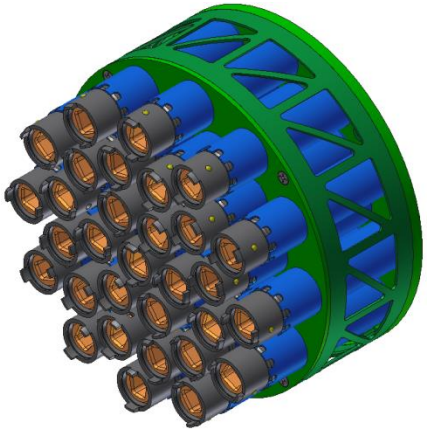


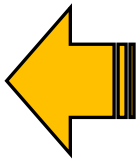
Each core stored in individual bits
[spare bits available]

Bit Sleeve Assembly

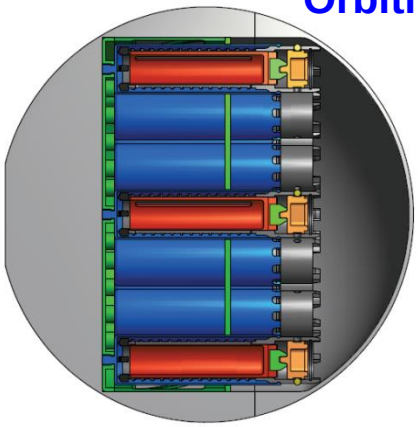
Each bit placed inside a sleeve within the cache and sealed

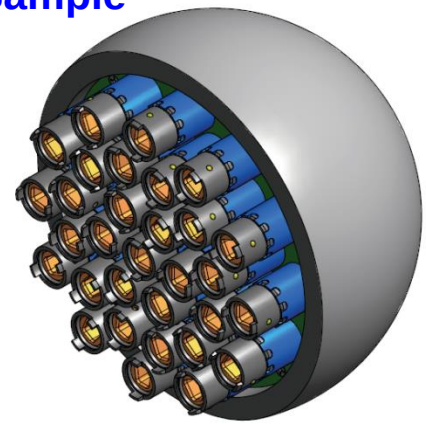
<2.5 kg (37 rocks)





Orbiting Sample





Example M2020 Architecture

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Core Drill

Drill Bits

Cache

Example M2020 Architecture

Mars 2020 - Live Technology Demonstrations

https://www.youtube.com/watch?v=VhfL3htrtZ8

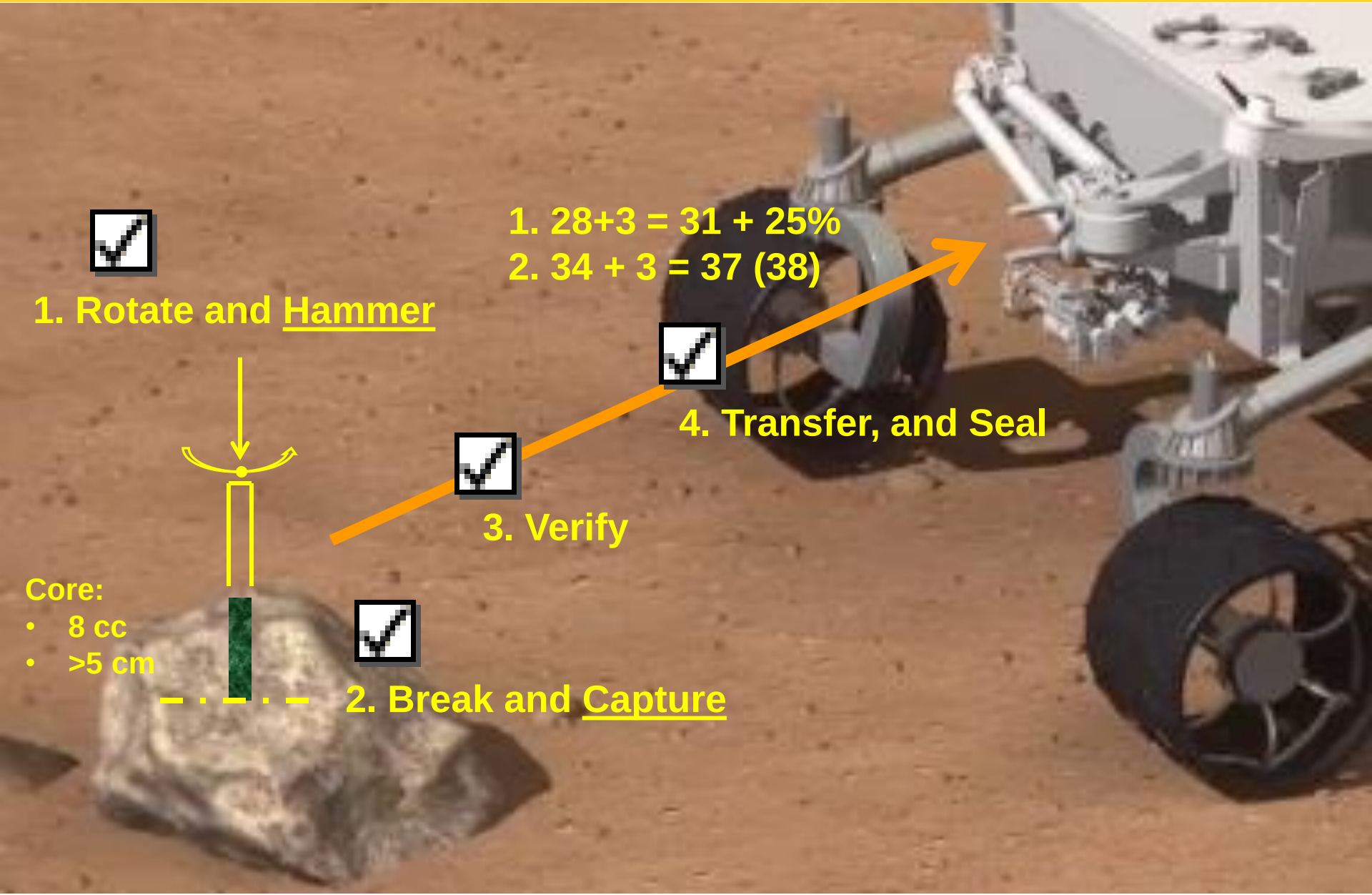
Honeybee Robotics - HD Mars 2020 Sample Acquisition and Caching Concept

https://www.youtube.com/watch?v=NphWPvi9cy4

Honeybee Robotics - Mars 2020 "SLOT bit" Sample Acquisition and Caching

https://www.youtube.com/watch?v=cf47bvULtEQ

Conclusions



Acknowledgements

- NASA's Mars Program
- NASA SBIR
- NASA PIDDP